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Zina Trost PhD , John Sturgeon PhD , Adam Guck PhD , Maisa Ziadni PhD , Liza Nowlin BS , Burel Goodin PhD , Whitney Scott PhD

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Highlights

- Perceived injustice predicted greater ratings of depression and disability
- Perceived injustice did not significantly predict intensity of low back pain
- Anger ratings mediated the effects of perceived injustice on depression
- Black participants reported greater perceived injustice and worse pain outcomes

Examining injustice appraisals in a racially diverse sample of individuals with chronic low back pain.

Trost, Zina, PhD[1], Sturgeon, John, PhD[2], Guck, Adam, PhD[3], Ziadni, Maisa, PhD[4], Nowlin, Liza, BS[5], Goodin, Burel, PhD[1], Scott, Whitney, PhD[6]

1 Department of Psychology, University of Alabama at Birmingham, Birmingham, AL, USA
2 Department of Anaesthesiology and Pain Medicine, University of Washington Medical Center, Seattle, WA, USA
3 Department of Family Medicine, John Peter Smith Health Network, Ft. Worth, TX, USA
4 Department of Anesthesiology, Stanford University School of Medicine, Palo Alto, CA USA
5 Texas Scottish Rite Hospital for Children, Dallas, TX USA
6 Department of Psychology, Institute of Psychiatry, Psychology, and Neuroscience, King's College London, England

Corresponding author: Zina Trost, Department of Psychology, University of Alabama at Birmingham, Birmingham, AL, USA; Tel: (917) 209-4866; Email: ztrost1@uab.edu

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ABSTRACT

Injustice perception has emerged as a risk factor for problematic musculoskeletal pain outcomes. Despite the prevalence and impact of chronic low back pain (CLBP) no study has addressed injustice appraisals specifically among individuals with CLBP. In addition, despite racial/ethnic disparities in pain, existing injustice research has relied almost exclusively on White/Caucasian participant samples. The current study examined associations between perceived injustice and pain, disability, and depression in a diverse community sample of individuals with CLBP (N=137) -- 51(37.2%) White, 43(31.4%) Hispanic, 43(31.4%) Black or African American). Anger variables were tested as potential mediators of these relationships. Controlling for demographic and pain-related covariates, perceived injustice accounted for unique variance in self-reported depression and disability outcomes, but not pain intensity. State and trait anger, and anger inhibition mediated association between perceived injustice and depression; no additional mediation by anger was observed. Significant racial differences were also noted. Compared to White and Hispanic participants, Black participants reported higher levels of perceived injustice related to CLBP, as well as higher depression, and pain-related disability. Black participants also reported higher pain intensity than White participants. Current findings provide initial evidence regarding the role of injustice perception specifically in the context of CLBP and within a racially diverse participant sample. Results highlight the need for greater diversity within injustice and CLBP research as well as research regarding socially-informed antecedents of injustice appraisals.

Perspective: Perceived injustice predicted worse outcomes in chronic low back pain, with effects partially mediated by anger. Black participants reported worse pain outcomes and higher injustice perception than White or Hispanic counterparts. Given racial inequities within broader health and pain-specific outcomes, this topic is critical for CLBP and perceived injustice research.

1. INTRODUCTION

Within the United States, low back pain (LBP) is a leading cause of pain [24,93] and disability [20,33,74], accounting for 52 million of all healthcare visits [20,93]. Although most LBP resolves quickly, up to 10% develop a chronic and disabling pain condition [41]. In turn, chronic LBP (CLBP) contributes to annual costs of nearly $300 billion, due substantially to lost wages and productivity [25,47,93]. Despite medical advances [30,50], the cost and incidence of CLBP are steadily on the rise [20,50][36].

In addition to established cognitive processes -- in particular, fearful and catastrophic appraisals of pain experience [78] -- research has highlighted the deleterious impact of injustice appraisals on musculoskeletal pain and injury outcomes (for review see [79,87,94]). Pain-related injustice perception is conceptualized as a cognitive appraisal reflecting severity and irreparability of pain- or injury-related loss, externalized blame, and unfairness [76,79]. Elevated injustice perception is associated with greater self-reported pain (e.g., [9,52,75,82,87,89,95] and disability (e.g.,[52,59,75,76,95,97]), symptoms of depression and posttraumatic stress (e.g., [32,68,80,87]), and worse treatment outcomes, such as following multidisciplinary rehabilitation [68,80] [94,96]. The salience of injustice appraisals to painful and/or chronic health conditions is not surprising given significant losses, stressors, and disruptions to valued goals that can accompany health impairment [28,56,69,76,94]. From a theoretical perspective, chronic pain and injury are thought to violate core social-cognitive assumptions that the world is inherently predictable and fair (i.e., Just World Belief [22,46]. Injustice perception is likewise conceptualized as a central antecedent to the emotional response of anger [67,91]; in line with this conceptualization, there is evidence that facets of anger (i.e., state, trait, expression, inhibition) serve as mechanisms linking perceived injustice to pain-related outcomes [67,92].

Consistent findings across whiplash injury [68], fibromyalgia [62], arthritis [29], pelvic pain [61], and samples comprising varied chronic pain conditions [67,91] suggest that injustice perception represents an important risk factor for musculoskeletal pain outcomes. However, while several mixed pain samples have included back complaints (e.g., [66]), *no study to date has addressed the role of injustice appraisals specifically among individuals with CLBP.* This is surprising given the noted prevalence and impact of CLBP. Existing literature on perceived injustice is further characterized by a striking lack of racial/ethnic diversity, with all but one study [87] reflecting largely homogenous, primarily White/Caucasian samples (for review, see [60,81]). Conversely, pain literature documents pronounced racial/ethnic disparities in chronic pain experience and care

[1,34]. Within the U.S., individuals identifying as Black/African American endorse more frequent and disabling pain across a number of conditions compared to other racial groups, most notably Whites [1,34]. Of particular relevance to the current study, substantial literature in the area of Worker's Compensation finds that African Americans show worse long-term outcomes following work-related back injury, including greater pain intensity, disability, and emotional distress [15,16,18]. This literature likewise identifies systemic racial disparities in evaluation, treatment, and litigation outcomes, highlighting the potential relevance of injustice appraisal [14,15,17,19,84]. Finally, despite growing representation within the U.S. population [39], relatively little is known about the pain experience of Hispanic Americans [40]. Such observations underscore mounting recognition of the need for racial/ethnic diversity within pain research [34].

The current study sought to address the above limitations by examining the association between perceived injustice and CLBP outcomes (pain intensity, disability, and depressive symptomatology) within a racially diverse sample of individuals with CLBP. Principal aims were to (a) characterize perceived injustice, pain, and psychosocial variables within the sample (attending to potential racial differences), (b) examine the unique contribution of perceived injustice to CLBP outcomes, and (c) replicate the theorized and previously demonstrated role of anger variables (state, trait, inhibition, expression) as a mechanisms in the association between injustice appraisal and pain outcomes [67,91,92]. Current findings are expected to inform understanding of contributors to a uniquely prevalent and disabling pain condition within a racially-representative participant sample.

2. METHOD

2.1 Participants

Participants were recruited from local community sources in the Southwestern region of the United States, specifically, recruitment comprised paper advertisements in public settings, newspapers, and online classifieds. Advertisements invited individuals to participate in paid research regarding chronic low back pain. Interested participants were screened by phone to determine study eligibility, at which time they were provided details regarding the study protocol, which involved a self-reported measures component (reported here) and subsequent physical and cognitive performance assessment (not reported here). There were no eligibility restrictions with respect to race or ethnicity. Participants were eligible for inclusion if they were at least 18 years of age and indicated the presence of low back pain for at least 6 months, with more than half the days

in the past 6 months, as well as significant interference of back pain in daily activities [24]. Screening likewise determined if low back pain was participants' primary source of perceived limitation/disability; accordingly, potential participants who reported co-occurring medical conditions (e.g., non-spinal arthritis, fibromyalgia) that significantly impacted daily function/mobility and participants who endorsed pregnancy were excluded from the study. Participants completed informed consent and self-report measures included in the current analysis prior to initiation of a behavioural testing protocol, described elsewhere [90], and were compensated $60.00 for completion of the full study protocol. (Note: while all participants completed the behavioral protocol described in [90], published results reflect only usable data and thus a smaller sample size). Study procedures were reviewed and approved by the University Institutional Review Board (IRB) at the University of North Texas.

2.2 Measures

Demographic Characteristics

In line with the recommended minimum dataset for CLBP [24], participants provided demographic information including gender, age, pain duration, racial identification, educational level, and income. Weight/height and marital status were also obtained.

Pain Intensity

Average pain intensity over the last two weeks was assessed using the Pain Rating Index of the McGill Pain Questionnaire - Short Form (MPQ-SF-PRI; [6,58]). The PRI reflects the summed ratings of 15 adjectives that describe sensory and affective dimensions of pain. Adjectives are ranked on a four-point scale from 0 (none) to 3 (severe). Scores range from 0 to 45, with higher scores indicating greater pain experience [37]. For the current study, Cronbach's alpha for the MPQ-SF-PRI was .92, indicating high internal consistency.

Self-Reported Disability

Self-appraised functional status / disability related to back pain was assessed using two instruments respectively intended to capture functional limitation due to CLBP and generalized pain interference across various life domains.

The Roland and Morris Disability Questionnaire (RMDQ; [64]) is recommended as a legacy measure in CLBP research [24] and assesses specific functional limitations due to CLBP. The RMDQ consists of 24 items regarding the difficulty of performing various activities of daily living due specifically to back pain (each item is qualified with the statement "because of my back"; e.g., "I avoid heavy jobs around the house because of my back"). Participants respond either "yes" or "no"

to each item; scores range from 0 to 24, with higher scores indicating greater self-reported functional disability. For the current study, Cronbach's alpha was .92, indicating high internal consistency.

The Pain Disability Index (PDI; [86]) was used to assess the degree to which participants perceived themselves to be disabled by pain across 7 areas of daily living: home, social, recreational, occupational, sexual, self-care, and life support activities (e.g., sleeping and eating). Participants provide a perceived disability rating for each domain, ranging from 0 (no disability) to 10 (total disability). Scores range from 0 to 70 with higher scores indicative of greater perceived pain-related disability. For the current study, Cronbach's alpha was .94, indicating high internal consistency.

Depressive Symptoms

The Patient Health Questionnaire-9 (PHQ-9; [45]) was used to measure depressive symptomatology. The PHQ-9 consists of 10 items and asks participants to indicate the frequency with which they experience each of the 9 symptoms included in the diagnostic criteria for Major Depression, as well as one item regarding any functional difficulty they associate with checked symptoms. Frequency scores range from 0 (not at all) to 3 (nearly every day). Total scores range from 0 to 27, with higher scores indicated greater depressive symptomatology. For the current study, Cronbach's alpha was .91, indicating high internal consistency.

Anger

Participants completed the State (STAXI-S; 15 items; α = .97), Trait (STAXI-T; 15 items; α = .90), Expression (STAXI-Ex; 8 items; α = .84), and Inhibition (STAXI-In; 8 items; α = .75) subscales of the State-Trait Anger Expression Inventory-II (STAXI-II; [72]). Anger State items reflect the intensity of an individual's angry feelings at the time of testing; Trait items reflect a person's general predisposition to become angry. The Anger Expression subscale assesses how often anger is outwardly expressed and the Anger Inhibition subscale assesses the frequency with which persons attempt to suppress anger feelings. Items are rated on a 4-point Likert-scale, with each item scored from 1 to 4; scores on the State and Trait subscales range from 15 to 60, while scores on the Expression and Inhibition subscales range from 8 to 32. Greater scores reflect greater state or trait anger, as well as greater tendency toward anger expression or inhibition.

Perceived Injustice

The Injustice Experiences Questionnaire (IEQ; [76]) was used to assess perceptions of injustice associated with chronic low back pain. Participants rated the frequency with which they

experienced each of 12 thoughts or feelings *when reflecting on their chronic pain condition*. Items are rated on a scale of 0 (never) to 4 (all of the time). IEQ items broadly reflect the associated factors of 'severity/irreparability of loss' and 'blame/unfairness'. Representative severity/irreparability items include "Most people don't understand how severe my condition is", and "My life will never be the same". Blame/unfairness items include "I am suffering because of someone else's negligence", and "It all seems so unfair". IEQ scores range from 0 to 48, with higher scores indicating higher appraisals of injustice related to chronic low back pain. The IEQ demonstrates strong psychometric properties, including sensitivity to change among individuals with persistent musculoskeletal pain [76,87]. Cronbach's alpha for IEQ in the current study was .92, indicating high internal consistency.

Pain Catastrophizing

The Pain Catastrophizing Scale (PCS; [78]) was used as a standard measure of catastrophic cognition about pain (i.e., a general negative orientation toward pain characterized by tendency to magnify, ruminate about, and feel helpless in the face of pain experience). Participants are asked to reflect on painful past experiences and indicate the degree to which they experienced each of 13 thoughts or feelings when in pain using a 5-point scale ranging from 0 (not at all) to 4 (all the time). PCS range from 0 to 52, with higher scores indicative of higher catastrophic cognition. Internal consistency for the current sample was high (α=.95).

2.3 Analytic plan

Means, standard deviations, and counts were calculated for relevant study variables. Male and female participants as well as individuals who identified as Black, White, or Hispanic were compared on all self-report measures. In preparation for subsequent modeling, bivariate correlations and analyses of variance (ANOVAs) were conducted to examine associations between participants' IEQ score, anger variables, and outcome variables, as well as interrelationships among measures. Significant ANOVA findings were followed by Bonferroni-corrected post hoc comparisons. These analyses provided a method for identifying pertinent covariates for analyses of each dependent variable. Separate multiple linear regression analyses were then conducted to examine the unique/incremental contribution of injustice perception (IEQ) to self-reported pain intensity, depression, and general and functional disability. Pain intensity, disability, and depressive symptoms were also included as covariates when their inclusion was deemed to be theoretically indicated (pain intensity and depression scores as covariates in predicting disability outcomes, pain intensity and disability scores as covariates in predicting depression, depression scores as

covariates in predicting pain intensity). Sociodemographic variables that showed significant bivariate association with a given outcome variable were entered into the first block of the regression; pain intensity, depression, disability, and/or pain catastrophizing scores were entered separately into subsequent blocks; IEQ score was entered into the final block of all regression analyses. Post-hoc power analyses conducted using G*Power version 3.0.10 [27]) suggested that the current sample was powered to detect regression effect sizes greater than .15 (regarding overall regression block effects) and incremental increases in R^2 greater than .11 at a power level of .80 (with an expected 7 predictors/degrees of freedom during covariate analyses). For all analyses, pairwise exclusion of missing data was employed as a means of maximizing the available data for analysis.

For outcome variables that showed a significant direct effect of the IEQ above and beyond relevant covariates/controls, path modeling was used to examine the mediating effects of the four STAXI-II subscales (State, Trait, Expression, and Inhibition). Each potential mediator was tested in a separate model. As part of mediation [49], a direct relationship between predictor and mediator variables was first estimated (*a* path), as was the effect of the mediator on each outcome above and beyond the effect of the predictor (*b* path). Mediation was deemed significant if the product of the *a* and *b* path coefficients (the *ab* product) was significant [49]. As above, covariates that showed significant association with each outcome variable were included in all paths. Mediation effects were estimated using the PROCESS macro [3]. All coefficients are presented in their standardized form to allow comparison regarding the relative size of the statistical relationships. The *ab* product coefficient, like the path estimates, is presented in standardized form (i.e., in units of standard deviation). Of note, given the cross-sectional nature of the current data, special caution should be applied in interpretation of current mediation results.

We also opted to include a set of moderation analyses, examining the role of self-identified racial status as a potential moderator of all examined relationships. This step was taken as a means of describing potential differences among racial groups but, given the lack of prior research on this topic, these analyses were not guided by specific theory and were instead exploratory in nature. In these models, the categorical variable representing racial status was entered as a predictor along with all other variables of interest (substantive predictors and covariates). In addition, an interaction term was computed as a product of racial status and each predictor (IEQ, anger variables) and was modeled along with effects of identified covariates in predicting each endogenous variable in the model. An example equation is described below:

$$PHQ\text{-}9 = \beta_1*Race + \beta_2*IEQ + \beta_3*Race*IEQ + \beta_4*Income + \beta_5*Gender + \beta_0$$

A significant interaction indicated an omnibus finding regarding potential differences between racial groups in terms of the main effect; in the instance of a significant finding, main effects for each group were then computed.

3. RESULTS

3.1 Participant Characteristics

Participant demographic characteristics are summarized in Table 1. Of the 137 participants who completed self-report measures, 73 were male and 64 were female; 51 (37.2%) identified as White, 43 (31.4%) identified as Black or African American, and 43 (31.4%) identified as Hispanic or Latino (although "Hispanic" technically denotes ethnicity rather than race, existing research and pilot testing with local participants indicated that most individuals identified "Hispanic" as a racial distinction [51]; therefore it is used here to refer to participants' racial self-identification). Participants ranged from 19 to 70 years of age (M = 41.86, SD = 12.2 and duration of CLBP ranged from 6 months to 39 years (M = 8.52 years, SD = 7.58). Median income was $10,000 to $20,000; 81.0% of the sample reported earning less than $40,000 per year. The overall sample means regarding perceived injustice scores were comparable with prior chronic pain samples [31,67]. Similarly, the study means were comparable to prior publications in terms of scores on the RMDQ [21,63], PDI [86], PHQ-9 [4], MPQ-PRI [73,83], as well as STAXI subscales [12,13]. All variables, with the exception of IEQ, RMDQ, and PHQ-9, included some degree of missing data. The exact counts for valid responses for each variable can be found in Table 1.

Female participants reported significantly more pain intensity ($t(2, 134) = -2.01$, $p = .05$) and depressive symptoms than male counterparts ($t(2, 135) = -2.15$, $p = .03$); female participants also had significantly higher scores on the anger inhibition subscale of the STAXI-II ($t(2, 134) = -2.30$, $p = .02$). No other significant gender differences were observed.

3.2 Racial Differences in Study Variables

No racial differences were observed in terms of participant age, BMI, or pain duration. Relative to Black and Hispanic participants, a significantly greater proportion of White participants reported income above the sample median ($\chi^2(2, N = 137) = 7.80$, $p = .02$). Similarly, there was a trend in higher educational attainment among White participants, followed by Black and subsequently Hispanic participants ($\chi^2(6, N = 137) = 76.48$, $p < .01$).

Notable racial differences were observed across study variables and are summarized in Figure 1 and Table 2. Specifically, in comparison to both White and Hispanic counterparts,

participants who identified as Black or African American reported significantly higher levels of perceived injustice related to CLBP ($F(2, 134) = 14.60$, $p < .001$), depressive symptoms ($F(2, 134) = 4.09$, $p = .019$), general disability ($F(2, 119) = 7.11$, $p = .001$), and functional disability related to back pain ($F(2, 134) = 13.29$, $p < .001$). Black or African American participants also reported significantly higher levels of pain catastrophizing compared to White and Hispanic participants ($F(2, 117) = 5.82$, $p = .004$). Finally, Black participants endorsed higher pain intensity ($F(2, 134) = 3.09$, $p = .04$) compared to White participants but did not differ from Hispanic participants on this measure.

In terms of anger-related variables, Black participants endorsed significantly higher State Anger ($F(2, 134) = 4.09$, $p = .009$) than White or Hispanic counterparts; Black participants also reported relatively higher levels of Anger Expression than White or Hispanic participants, but racial differences on this measure did not reach statistical significance ($F(2, 134) = 1.28$, $p = .08$). Hispanic and White participants did not differ significantly on any of the above study variables.

3.3 Bivariate Correlations Among Study Variables

Table 3 shows bivariate correlations among study variables. Age was significantly positively associated with self-reported pain intensity, perceived injustice (IEQ score) and disability (RMDQ and PDI); age was significantly negatively associated with participants' scores on the Anger Expression and Anger Inhibition subscales of the STAXI-II. Self-reported income was negatively associated with pain intensity, perceived injustice, disability (RMDQ and PDI), depression, and pain catastrophizing. Higher income was associated with lower scores on the STAXI-II State subscale. Finally, participants' BMI showed significant positive association with pain intensity, perceived injustice, and disability. Perceived injustice showed moderate to strong positive correlations with pain intensity ($r = .52$), disability ($r = .68$ and $r = .72$ for RMDQ and PDI, respectively), pain catastrophizing ($r = .62$), and depression ($r = .64$), as well as each of the anger subscales ($r = .33$, $r = .50$, $r = .26$, and $r = .34$, for State, Trait, Expression, and Inhibition, respectively). Of note, self-reported income was positively skewed and a log transformation was conducted. All correlations followed the same pattern and were of similar levels of significance when the log transformed versus original data were used, and we present the non-transformed data in the remainder of the manuscript for ease of interpretation.

3.4 Prediction of CLBP Outcomes by IEQ and Mediation by Anger Variables

The Association between Anger and Perceived Injustice

As a first condition of mediation, the relationship between IEQ score and each of the mediators (STAXI-II subscales) was tested (*a* path). IEQ scores showed a significant relationship with STAXI-S (β = .453, $p < .001$, total model $r^2 = .262$), above and beyond inclusion of relevant covariates (income and race). IEQ was also a significant predictor of STAXI-T (β = .268, $p < .001$, total model $r^2 = .113$), above and beyond the effects of race. IEQ significantly predicted STAXI-In scores (β = .319, $p < .001$, total model $r^2 = .132$) above and beyond the effects of study covariates (income, race, and gender), as well as STAXI-Ex scores (β = .259, $p = .009$, total model $r^2 = .074$), above and beyond the effects of age, BMI, race, and income.

Depression

Multiple linear regression analyses were used to examine the unique/incremental contribution of injustice perception to each outcome variable (see Table 4). When entered into the final block of the analysis, perceived injustice scores significantly contributed an additional 2.8% variance to the model ($F\Delta = 7.04$, $p < .01$) above and beyond the contribution of sociodemographic variables (gender, race, and income), pain intensity scores, disability scores, and catastrophizing (accounting for 12.8%, 23.8%, 11.2%, and 6.0% of variance in PHQ-9 scores, respectively).

For the mediation analysis, a significant direct effect on PHQ-9 scores was found for STAXI-S (β = .297, $p < .001$, total model $r^2 = .628$), STAXI-T (β = .312, $p < .001$, total model $r^2 = .651$), STAXI-In (β = .157, $p = .024$, total model $r^2 = .590$), and STAXI-Ex scores (β = .127, $p = .049$, total model $r^2 = .585$) above and beyond that of the predictor (IEQ score) and covariates (*b* path). When mediation analyses were conducted, only STAXI-S (standardized $ab = .135$, $p < .05$), STAXI-T scores (standardized $ab = .084$, $p < .05$), and STAXI-In (standardized $ab = .050$, $p < .05$) were found to mediate the relationship between IEQ and PHQ-9 scores, above and beyond the effect of covariates.

Disability

Injustice perception scores significantly contributed 5.1% of variance to self-reported functional disability (RMDQ) scores ($F\Delta = 13.41$, $p < .01$). The effect of IEQ was significant, above and beyond the effects of associated sociodemographic variables (age, race, gender, income, BMI), pain intensity, depressive symptoms, and pain catastrophizing scores (which accounted for 20.6%, 17.2%, 11.2%, and 5.6% of variance in RMDQ scores, respectively). Similarly, IEQ scores were found to significantly account for an additional 4.3% of variance in general disability (PDI) ratings ($F\Delta = 18.23$, $p < .01$). These effects occurred above and beyond the effects of sociodemographic variables (age, race, gender, income, BMI), as well as pain intensity, depressive symptoms, and pain

catastrophizing, which accounted for 21.5%, 36.4%, 7.4%, and 5.0% of the variance in PDI scores, respectively.

Controlling for the effects of IEQ and relevant covariates, there was no association observed between RMDQ scores and the STAXI-II subscales: STAXI-S (β = .038, p = .66, total model r^2 = .632), STAXI-T (β = -.095, p = .21, total model r^2 = .637), STAXI-Ex (β = -.118, p = .08, total model r^2 = .642), or STAXI-In scores (β = -.002, p = .98, total model r^2 = .631). Similarly, PDI scores were not found to be significantly associated with any of the STAXI-II subscales above and beyond the effects of the IEQ and covariates: STAXI-S (β = .076, p = .37, total model r^2 = .724), STAXI-T (β = .076, p = .24, total model r^2 = .719), STAXI-Ex (β = .019, p = .75, total model r^2 = .716), or STAXI-In scores (β = .025, p = .70, total model r^2 = .716). None of the STAXI subscales were found to significantly mediate the relationships between the IEQ and either the RMDQ or PDI, above and beyond the effects of study covariates (p > .05 in all cases).

Pain Intensity

When entered into the final block of multiple regression analyses, perceived injustice scores did not significantly contribute variance to the prediction of pain intensity (MPQ-SF-PRI) scores ($F\Delta$ = 14.41, p = .13), above and beyond the effects of associated sociodemographic variables (age, race, gender, income, BMI), depressive symptoms, and pain catastrophizing scores (which accounted for 13.6%, 21.9%, and 8.9% of variance in MPQ-SF-PRI scores, respectively).

Above and beyond the effects of IEQ and covariates in the model, there was not a significant relationship between MPQ-SF-PRI scores and any of the STAXI-II subscales: STAXI-S (β = .109, p = .15, total model r^2 = .537), STAXI-T (β = -.054, p = .44, total model r^2 = .531), STAXI-In (β = .000, p = .99, total model r^2 = .528), or STAXI-Ex scores (β = -.020, p = .75, total model r^2 = .528). None of the STAXI subscales were found to significantly mediate the relationships between the IEQ and MPQ-SF-PRI, above and beyond the effects of study covariates (p > .22 in all cases).

Moderation by Race

Given consistent racial differences in study outcome variables, self-reported racial status was tested as a moderator for the observed associations between perceived injustice and self-reported pain intensity, disability, and depression. Subsequent analyses showed that racial status did not moderate the association between IEQ and MPQ-SF-PRI scores (β = .256, p = .31), PHQ-9 scores (β = -.067, p = .81), RMDQ scores (β = .109, p = .62), or PDI scores (β = .103, p = .63).

For anger variables, racial status was found to moderate the relationship between perceived injustice and STAXI-T scores (β = -.472, p = .033); this interaction suggested a relatively

stronger relationship between IEQ scores and STAXI-T scores in Black or African American participants (β = .469, $p < .001$) compared to White (β = .173, $p = .16$) and Hispanic participants (β = .379, $p = .014$). Race did not moderate the relationship between IEQ and other subscales of the STAXI-II ($p > .06$ in all cases).

4. DISCUSSION

The current study is the first to examine the association between perceived injustice and physical and psychological outcomes specifically in the context of chronic low back pain. It is likewise first to examine these relationships within a racially diverse participant sample. Current findings are consistent with existing studies showing a positive association between injustice perception and pain, depression, and disability across a number of chronic pain conditions [67,76,77] as well as in acute trauma and rehabilitation settings [11,60,80,87]. Perceived injustice accounted for unique variance in cross-sectional prediction of disability and depression when controlling for significant sociodemographic factors and major psychosocial contributors to CLBP (i.e., depression and catastrophizing). Specific focus on CLBP and CLBP-outcomes was integral to the current study. Given its ubiquity and impact within the US and worldwide, CLBP is recognized as a unique target of empirical inquiry [2], guided by specific research standards (i.e., NIH Task Force on Research Standards for Chronic Low Back Pain [24]). However, despite burgeoning literature on the deleterious impact of injustice appraisals in *mixed* chronic pain samples (which often reference back pain/injury), no studies have replicated these effects *specifically in a CLBP context*. The current findings provide an empirical foundation for future CLBP research by demonstrating the incremental value of injustice beliefs within this population.

Recent research has increasingly focused on mechanisms of action that may drive the effects of perceived injustice. Theoretical literature suggests that perceived injustice is a key cognitive antecedent to the experience of anger [91]. Current findings and previous studies support a robust positive association between perceived injustice and anger variables [67,75,88,91]. In line with previous studies [66,67,92], anger variables in the current study mediated the relationship between perceived injustice and depressive symptoms but did not extend to measures of self-reported disability or pain intensity [67]. These findings suggest that there may be other mechanisms (e.g., behavioral avoidance, treatment non-adherence) that more closely correspond to functional outcomes but are inadequately explained by emotional factors such as anger. Although not measured directly, the observed mediation effects may reflect the potential of anger to disrupt meaningful social relationships and contribute to greater distress, conflict, and isolation, ultimately

undermining psychological adjustment [67,75]. In line with this, anger expression was found to mediate association between pain-related injustice perception and impaired therapeutic alliance among individuals receiving multidisciplinary rehabilitation for chronic musculoskeletal pain [70]. Notably, in the current study anger expression emerged as the only STAXI subscale that did not mediate depression outcomes. These differential findings may owe to critical sample differences (i.e., participants in the current sample reported substantially longer pain duration than rehabilitation patients).

In addition to anger, *acceptance* has emerged as a potential mechanism of perceived injustice outcomes [10,31,52]. Contrasted with efforts to avoid or "solve" persistent pain [26], pain acceptance refers to engaging in value-driven activity with the goal of living a fulfilling life despite continued pain experience [26,54]. Conceptually, acceptance stands in contrast to injustice perception, characterized by emphasis on loss and irreparability[31]; in line with this, acceptance and injustice perception are negatively correlated in the literature (e.g., [62]). In a recent study of a mixed pain sample [10] acceptance was found to function in parallel to anger as in mediating the effects of perceived injustice on pain, disability, and opioid prescription. Future studies examining mechanisms of action in injustice appraisal should consider inclusion of acceptance and anger to replicate and extend current findings.

A central aim of the current study was to characterize the current sample with respect to pain and psychosocial outcomes. Echoing earlier findings of race disparities in work-related low back pain [15,16,18,85] as well as other chronic pain conditions [1,34], Black participants in the current study reported significantly more pain, disability, pain catastrophizing, and depression than White or Hispanic counterparts. Critically, Black participants endorsed significantly greater perceived injustice with respect to CLBP than either White or Hispanic participants. This is a notable observation because, to date, the vast majority of literature has addressed pain-related injustice appraisals in predominantly or exclusively Caucasian samples. The finding of higher injustice perception among Black participants is consistent with differences identified by Trost et al. (2015) among individuals discharged from severe trauma hospitalization; to our knowledge, this is the only other study to collect injustice appraisals from a racially diverse participant sample. While current analyses examining potential moderation by race were largely non-significant (it is probable that the relatively stronger relationship between IEQ and trait anger scores would not have survived post-hoc adjustments for multiple comparisons), these finding represent an initial

step in highlighting the unequal distribution and potential impact of pain-related injustice perception across racial groups.

In the same vein, current findings offer tentative insight regarding factors that may contribute to development and maintenance of pain-specific injustice appraisals. Substantial research testifies to the deleterious health impact of broader social inequities or injustice experiences (e.g., racial discrimination, unfair hierarchical treatment, low social status; [23,35,42,43]). For instance, the Perceived Unfairness Model [42] defines repeated exposure to unjust societal experiences as a distinct form of stress, ultimately shaping poorer health prognoses among African Americans. However, despite clear evidence of the destructive impact of discriminatory experiences [5,42,44], studies have yet to examine the interface of such societal- and individual-level inequities with injustice appraisals regarding a specific pain condition like CLBP. For example, it is plausible that, in the context of back injury, a lifetime history of race-related injustice experiences [8] may reinforce pain-related injustice appraisals and ultimately contribute to worse pain- and disability-specific outcomes. In line with the potential impact of existing sociodemographic factors, CLBP injustice appraisals were negatively associated with socioeconomic indicators like income (which also showed difference between Black and White participants), potentially reflecting the greater burden of physical injury and disability on individuals with lower financial resources [48,65]. These findings again highlight the broader sociocultural context within which injustice appraisals arise and the increasingly recognized role of social and interpersonal processes within injustice literature [55,57,60,61,75]. Recent findings of negative association between perceived injustice and patient-provider interactions [70] is perhaps particularly relevant here given evidence of racial inequities in pain treatment [1,14,19,34,84] and mistrust of the medical establishment within minority communities [36,71].

Limitations and Future Directions

As noted, our findings are taken from a cross-sectional dataset, and the proposed mediation model is limited in this respect. We are not able to state definitively that the proposed variables follow a causal or temporal order as they are represented in our model; there is reasonable argument that these factors may more appropriately be considered mutually influential. Individuals in pain may become more disabled or more depressed, and may thus experience more anger or appraise their pain experience as more unjust. We urge replication of our findings within larger CLBP samples that may reflect greater racial and socioeconomic diversity, as well as extension of our findings in longitudinal and intervention studies that may better delineate the temporal and

causal relationships between these variables. For example, while our analyses suggest presence of both potential moderators and mediators in examining the role of injustice appraisal and anger across racial groups, our relatively limited sample size did not facilitate sufficient power to estimate moderated mediation models; this approach would likely be appropriate for future, larger studies. Similarly, results of post-hoc power analysis suggested that our sample may have been underpowered to detect subtler effects in our regression and mediation analyses, particularly with presence of missing data on some variables that further reduced sample size for analysis. Thus, while our analysis yielded several significant effects, our non-significant findings should be interpreted with this caution in mind.

In terms of future directions, the incremental contribution of IEQ scores to CLBP outcomes above and beyond other pain-relevant factors suggest that non-biological treatment approaches to CLBP may benefit from inclusion of individuals' pain-related injustice appraisals alongside traditional cognitive-behavioral targets, namely catastrophic and fearful appraisals. In addition to individual-level intervention, observed racial differences suggest the potential utility of systems-level interventions that address possible antecedents to elevated injustice appraisals both within medical contexts (e.g., provider-education [7,38]) and broader social structures. Further, given the critical importance of identifying potential risk factors that contribute to the transition from acute to chronic pain status in back injury [77], a longitudinal perspective – currently largely absent within the perceive injustice literature -- would be particularly valuable with this population. Additionally, recent studies have linked higher injustice perception with greater likelihood of opiate use and maintenance [9,69]; given that 25% of individuals with CLBP report aberrant medication use [53] it may be particularly important to examine the role of injustice appraisals in the natural course of treatment for CLBP.

Conclusion

The current study examined an increasingly recognized psychological risk factor in the context of a highly prevalent pain condition and within a racially diverse participant sample. Findings support the contribution of injustice appraisals to functional and psychosocial outcomes among individuals with CLBP, above and beyond sociodemographic and psychosocial contributors. Findings add to the growing literature on racial disparities in injustice appraisals in musculoskeletal pain and injury. The current findings highlight the relative dearth of research addressing health-related injustice beliefs within minority populations and the need for prospective designs regarding injustice appraisals in CLBP.

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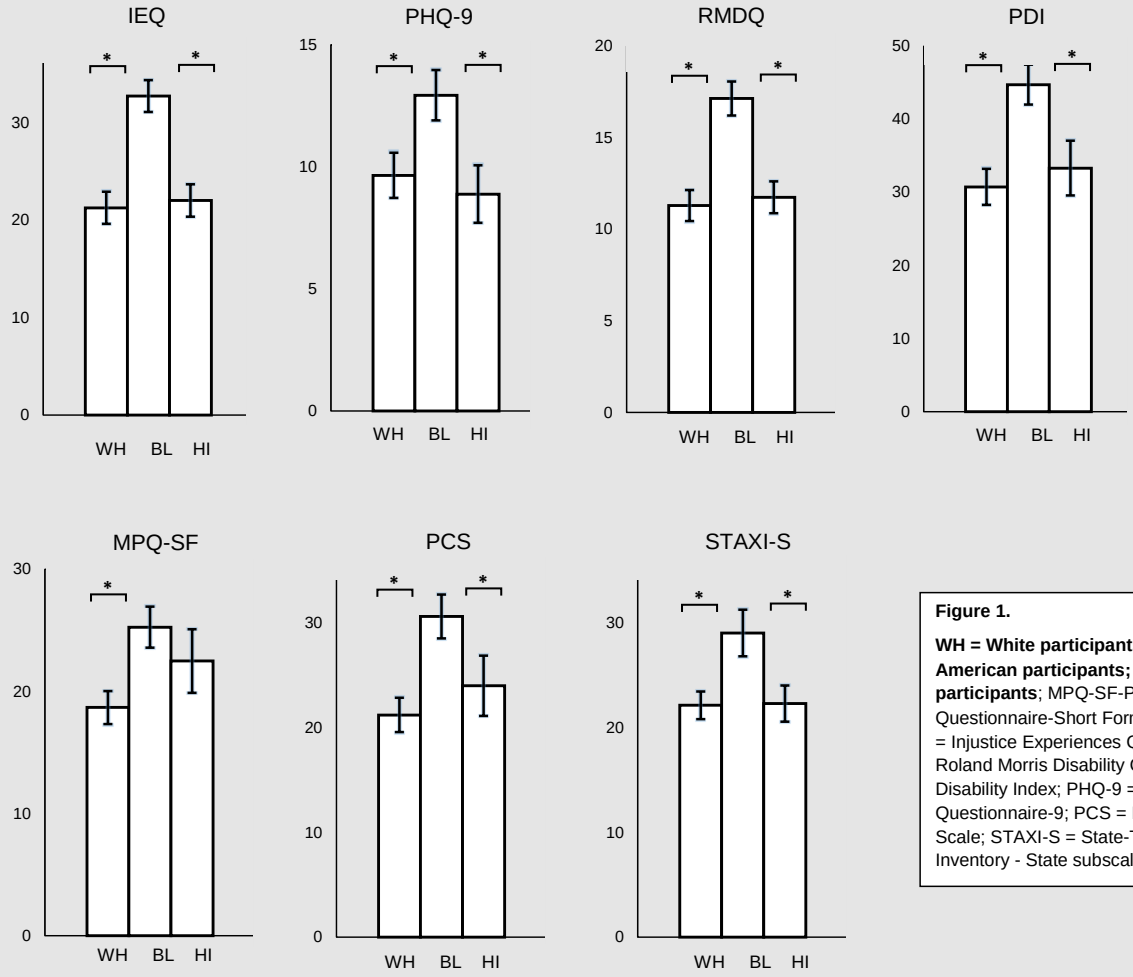

Figure 1.

WH = White participants; BL = Black/African American participants; HI = Hispanic participants; MPQ-SF-PRI = The McGill Pain Questionnaire-Short Form-Pain Rating Index; IEQ = Injustice Experiences Questionnaire; RMDQ = Roland Morris Disability Questionnaire; PDI = Pain Disability Index; PHQ-9 = Patient Health Questionnaire-9; PCS = Pain Catastrophizing Scale; STAXI-S = State-Trait Anger Expression Inventory - State subscale), * $p < .05$.

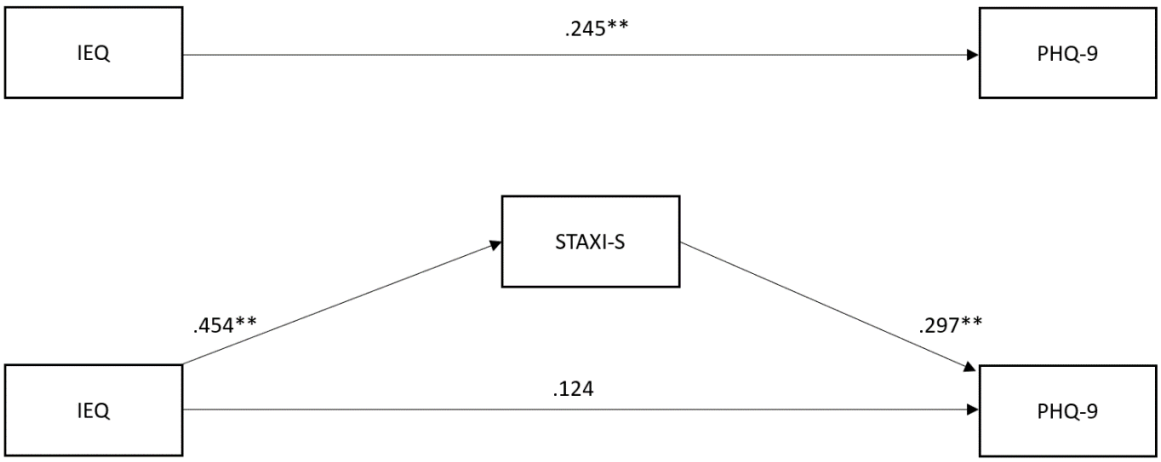

Figure 2.

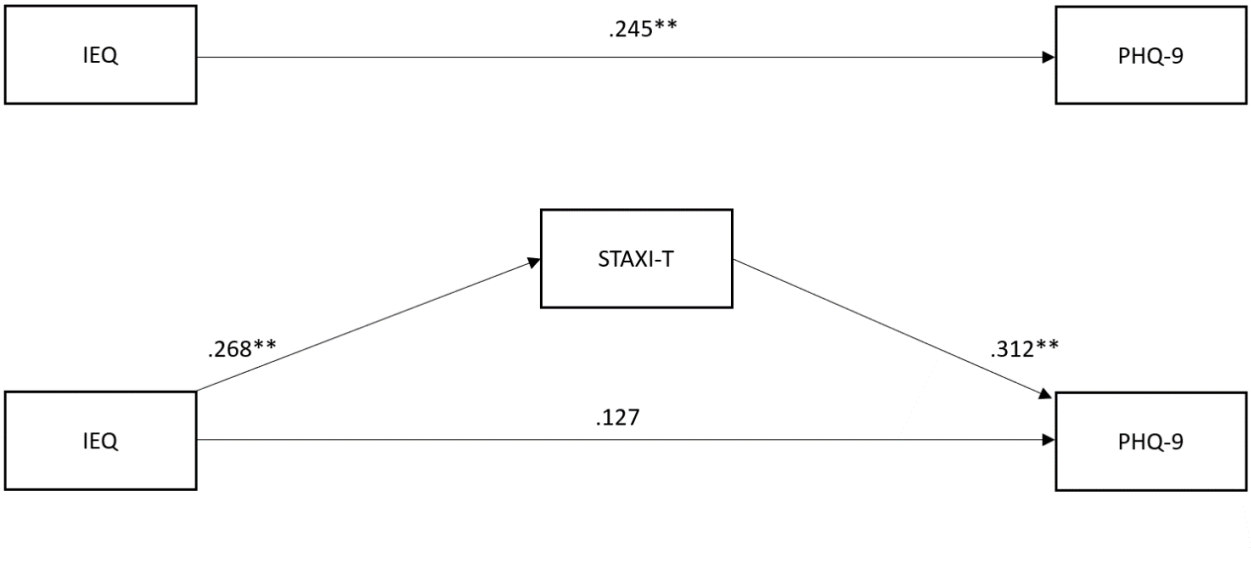

Figure 3.

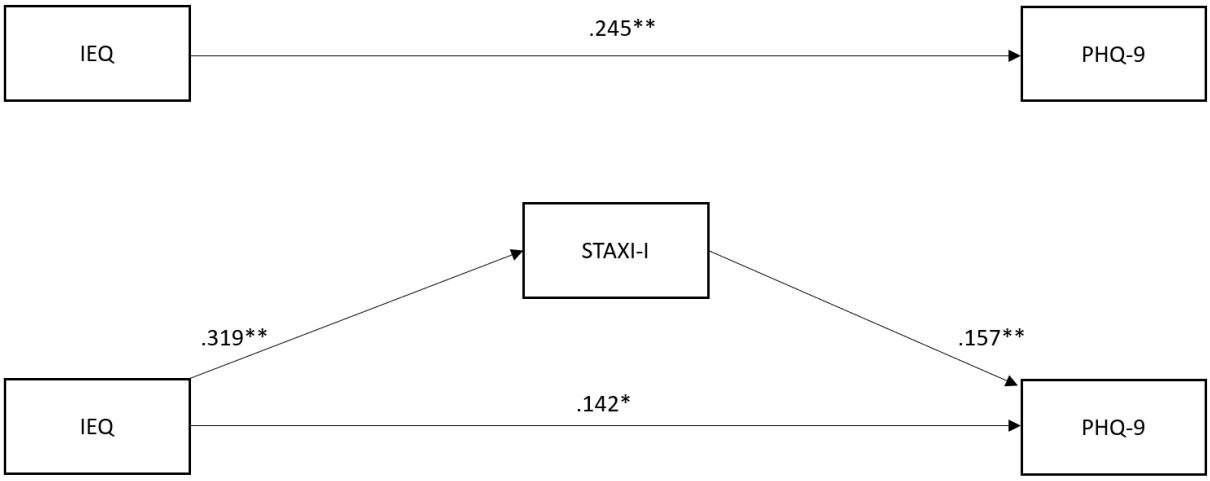

Figure 4.

Table 1. Sample Characteristics: Demographic Variables

		N (%) or Mean (SD)
Gender	Female	64 (46.7%)
	Male	73 (53.3%)
Age (yrs.)		40.99 (12.3)
Pain Duration (yrs.)		8.52 (7.6)
BMI (kg/m^2)		29.72 (9.3)
Race	White	51 (37.2%)
	Black or African American	43 (31.4%)
	Hispanic or Latino	43 (31.4%)
Marital Status	Married	43 (31.4%)
	Separated	12 (8.8%)
	Widowed	2 (1.5%)
	Divorced	15 (10.9%)
	Single	65 (47.4%)
Education Level	Less than HS	20 (14.6%)
	HS Diploma	18 (13.1%)
	Some College (non-degree)	42 (30.7%)
	Associate's	8 (5.8%)
	Bachelor's	11 (8.0%)
	Graduate/Professional	6 (4.4%)
	Would rather not say	29 (21.2%)
	Missing	2 (2.2%)

Income	<10K	49 (35.8%)
	10-19K	33 (24.1%)
	20-29K	11 (8.0%)
	30-39K	18 (13.1%)
	40-49K	10 (7.3%)
	50+K	16 (11.7%)

Table 2. Descriptive Statistics for Pain, Disability, and Psychosocial Outcomes

Mean (SD)	Total Sample (N = 137)	Range of Scores (min.-max.)	Black Participants (n = 43)	Hispanic Participants (n = 43)	White Participants (n = 51)
MPQ-SF-PRI	21.58 (13.05)	0 - 45	25.25 (11.00) [a]	22.49 (17.11)	18.68 (9.59)
RMDQ	13.19 (6.53)	0 - 24	17.14 (6.10) [b]	11.74 (5.70)	11.29 (6.04)
PDI	35.79 (18.78)	3 - 70	44.73 (17.24) [b]	33.31 (20.11)	30.75 (17.59)
PHQ-9	10.29 (7.08)	0 - 27	12.93 (6.76) [b]	8.88 (7.73)	9.65 (6.59)
PCS	35.11 (13.69)	2 - 52	30.63 (13.25) [b]	24.00 (15.49)	21.22 (11.66)
IEQ	24.81 (12.44)	0 - 48	32.72 (10.76) [b]	22.00 (10.90)	21.25 (11.80)
STAXI - S	24.14 (11.86)	0 - 60	29.05 (14.44) [b]	22.30 (11.33)	22.14 (9.41)
STAXI - T	18.00 (6.82)	6 - 40	18.83 (8.28)	17.07 (6.07)	17.75 (5.34)
STAXI - Ex	15.32 (4.97)	7 - 32	16.55 (5.35)	14.19 (4.83)	14.98 (4.77)
STAXI - In	19.14 (5.09)	8 - 32	18.52 (5.11)	18.98 (5.25)	17.35 (4.98)

Note: [a] Score is significantly greater than White participants at $p < .05$; [b] Score is significantly greater than both Hispanic and White participants at $p < .05$; MPQ-SF-PRI = The McGill Pain Questionnaire-Short Form-Pain Rating Index; IEQ = Injustice Experiences Questionnaire; RMDQ = Roland Morris Disability Questionnaire; PDI = Pain Disability Index; PHQ-9 = Patient Health Questionnaire-9; PCS = Pain Catastrophizing Scale; STAXI = State-Trait Anger Expression Inventory (S: State; T: Trait; Ex: Expression, In: Inhibition)

Table 3. Associations between Study Variables

Variable	N	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age	134	-												
2. Income	137	-.05	-											
3. BMI (kg/m^2)	133	.20*	-.02	-										
4. Pain Duration (yrs.)	136	.29**	-.07	-.01	-									
5. MPQ-SF-PRI	136	.18*	-.21*	.18*	-.00	-								
6. IEQ	137	.23**	-.25**	.24**	.14	.52**	-							
7. RMDQ	137	.29**	-.27**	.28**	.12	.53**	.68**	-						
8. PDI	120	.35**	-	.21*	.07	.72**	.72**	.75**	-					

			.25**											
9. PHQ-9	137	.11	-.27**	.13	.12	.55**	.64**	.60**	.63**	-				
10. PCS	120	.16†	-.25**	.08	.08	.61**	.62**	.63**	.71**	.64**	-			
11. STAXI-T	136	-.16†	-.11	.03	-.06	.28**	.33**	.25**	.34**	.56**	.40**	-		
12. STAXI-S	136	-.03	-.20*	.05	.01	.44**	.50**	.49**	.54**	.63**	.57**	.71**	-	
13. STAXI-Ex	136	-.24**	-.01	.12	-.11	.20*	.26**	.15†	.24**	.35**	.34**	.74**	.54**	-
14. STAXI-In	136	-.180*	-.11	.11	-.07	.32**	.33**	.30**	.35**	.38**	.39**	.54**	.41**	.54**

*Note: * p < .05, **p < .01, †p <.10*; MPQ-SF-PRI = The McGill Pain Questionnaire-Short Form-Pain Rating Index; IEQ = Injustice Experiences Questionnaire; RMDQ = Roland Morris Disability Questionnaire; PDI = Pain Disability Index; PHQ-9 = Patient Health Questionnaire-9; PCS = Pain Catastrophizing Scale; STAXI = State-Trait Anger Expression Inventory (S: State; T: Trait; Ex: Expression, In: Inhibition)

Table 4. Regression Analyses

Outcome Variable			N	R^2 change	$F\Delta$	β	t
Depression (PHQ-9)	Step 1		118	.13	5.64**		
		Gender				.21*	2.43
		Race				.12	1.33
		Income				-.31**	-3.50
	Step 2			.24	42.88**	.51**	6.55
		MPQ-SF PRI					
	Step 3			.11	24.28**	.41**	4.92
		RMDQ					
	Step 4			.06	14.70**	.35**	3.83
		PCS					
	Step 5			.03	7.04**	.25**	2.65
		IEQ					
			N	R^2 change	$F\Delta$	β	t
Functional Disability (RMDQ)	Step 1		116	.21	5.76**		
		Age				.24**	2.76
		Gender				.05	.60
		Race				.03	.33
		Income				-.27**	-3.06
		BMI				.23*	2.62
	Step 2			.17	30.52**	.45**	5.53
		MPQ-SF-PRI					
	Step 3			.11	24.02**	.42**	4.90
		PHQ-9					
	Step 4			.06	13.22**	.34**	3.64
		PCS					

	Step 5		.05	13.41**	.33**	3.66
	IEQ					
		N	R^2 change	$F\Delta$	β	t
Disability (PDI)	Step 1	116	.22	6.09**		
	Age				.33**	3.79
	Gender				.13	1.52
	Race				-.03	-.39
	Income				-.23**	-2.65
	BMI				.14	1.61
	Step 2		.36	95.02**	.65**	9.75
	MPQ-SF-PRI					
	Step 3		.07	23.36**	.34**	4.83
	PHQ-9					
	Step 4		.05	18.35**	.33**	4.28
	PCS					
	Step 5		.04	18.23**	.30**	4.27
	IEQ					
		N	R^2 change	$F\Delta$	β	t
Pain Intensity	Step 1	116	.14	3.50**		
(MPQ-SF-PRI)	Age				.17	1.84
	Gender				.20*	2.21
	Race				-.06	-.66
	Income				-.20*	-2.18
	BMI				.13	1.46
	Step 2		.22	37.46**	.51**	6.12
	PHQ-9					
	Step 3		.09	17.41**	.40**	4.17
	PCS					
	Step 4		.01	1.13	.11	1.06
	IEQ					

Note: * $p < .05$, ** $p < .01$; MPQ-SF-PRI = The McGill Pain Questionnaire-Short Form Pain Rating Index; IEQ = Injustice Experiences Questionnaire; RMDQ = Roland Morris Disability Questionnaire; PDI = Pain Disability Index; PHQ-9 = Patient Health Questionnaire-9; PCS = Pain Catastrophizing Scale; STAXI = State-Trait Anger Expression Inventory (S: State; T: Trait; Ex: Expression, In: Inhibition)